CLAIMS

1. A threshold value matrix used for converting a
multi-level image data into a plural-level image data which

5   represents a dot pattern by a smaller number of gradation
levels than the multi-level image data, comprising:

threshold values used for making a dot representation
solely by a dot pattern while maintaining an identical keytone
for all halftone levels.

10

2. The threshold value matrix as claimed in claim
1, further comprising:

a plurality of sub matrixes; and

a basic matrix for combining the sub matrixes,

15   said sub matrixes and said basic matrix having similar
line-group keytones.

3. The threshold value matrix as claimed in claim
2, wherein at least said sub matrixes have a size of 3 x 3 and

20   an inclined line-group keytone.

4. The threshold value matrix as claimed in any of
claims 1 to 3, which is used to always simultaneously generate
three or more dots per gradation level.

25

5. The threshold value matrix as claimed in any of claims 1 to 4, wherein a threshold value immediately before switching a dot size has a value identical to a first threshold value for a dot size of a next stage.

5

6. The threshold value matrix as claimed in any of claims 1 to 5, which excludes a matrix which independently generates a dense dot pattern for which a keytone is not visually recognizable by human eye.

10

7. The threshold value matrix as claimed in any of claims 1 to 6, wherein only odd numbered threshold values are used to form an incomplete set of dots at a gradation level where a keytone is easily lost due to increased dot density.

15

8. The threshold value matrix as claimed in any of claims 1 to 7, wherein one side of the threshold value matrix is always a multiple of eight.

20   9. An image processing apparatus comprising:
a processing section carrying out a plural-level process with respect to a multi-level image data to output a plural-level image data which represents a dot pattern by a smaller number of gradation levels than the multi-level image data by
25   use of a threshold value matrix; and

a holding section holding said threshold value matrix
which includes threshold values which are used for making a
dot representation solely by a dot pattern while maintaining
an identical keytone for all halftone levels.

5

10. The image processing apparatus as claimed in
claim 9, wherein said processing section uses the threshold
value matrix by rotating the threshold value matrix based on
the multi-level image data or specified output setting

10   information.

11. The image processing apparatus as claimed in
claim 10, wherein said processing section rotates the
threshold value matrix so that directions of keytones are

15   identical between a portrait mode which uses an output picture
vertically so that a longer side of the picture is vertical
and a landscape mode which uses the output picture
horizontally so that the longer side of the picture is
horizontal.

20

12. The image processing apparatus as claimed in
any of claims 9 to 11, wherein said threshold value matrix
comprises a plurality of sub matrixes, and a basic matrix for
combining the sub matrixes, said sub matrixes and said basic

25   matrix having similar line-group keytones.

13. The image processing apparatus as claimed in claim 12, wherein at least said sub matrixes have a size of 3 x 3 and an inclined line-group keytone.

5   14. The image processing apparatus as claimed in any of claims 9 to 13, wherein said holding section holds a threshold value matrix which is used to always simultaneously generate three or more dots per gradation level.

10   15. The image processing apparatus as claimed in any of claims 9 to 14, wherein a threshold value immediately before switching a dot size has a value identical to a first threshold value for a dot size of a next stage, within the threshold value matrix.

15

16. The image processing apparatus as claimed in any of claims 9 to 15, wherein said holding section holds the threshold value matrix excluding a matrix which independently generates a dense dot pattern for which a keytone is not

20   visually recognizable by human eye.

17. The image processing apparatus as claimed in any of claims 9 to 16, wherein said holding section holds the threshold value matrix in which only odd numbered threshold

25   values are used to form an incomplete set of dots at a

gradation level where a keytone is easily lost due to
increased dot density.

18.   The image processing apparatus as claimed in
5   any of claims 9 to 17, wherein one side of the threshold value
matrix is always a multiple of eight.

19.   A printer driver, to be implemented in a
computer, for supplying an output image data to an image
10   forming apparatus which forms an image from a plurality of
dots, comprising:
     a processing section carrying out a plural-level process
with respect to a multi-level image data to output, as the
output image data, a plural-level image data which represents
15   a dot pattern by a smaller number of gradation levels than the
multi-level image data by use of a threshold value matrix; and
     a table storing said threshold value matrix which
includes threshold values which are used for making a dot
representation solely by a dot pattern while maintaining an
20   identical keytone for all halftone levels.

20.   The printer engine as claimed in claim 19,
wherein said processing section uses the threshold value
matrix by rotating the threshold value matrix based on the
25   multi-level image data or specified output setting information.

21. The printer engine as claimed in claim 20, wherein said processing section rotates the threshold value matrix so that directions of keytones are identical between a portrait mode of the image forming apparatus which uses an

5 output picture vertically so that a longer side of the picture is vertical and a landscape mode of the image forming apparatus which uses the output picture horizontally so that the longer side of the picture is horizontal.

10 22. The printer engine as claimed in any of claims 19 to 21, wherein said threshold value matrix comprises a plurality of sub matrixes, and a basic matrix for combining the sub matrixes, said sub matrixes and said basic matrix having similar line-group keytones.

15

23. The printer engine as claimed in claim 22, wherein at least said sub matrixes have a size of 3 x 3 and an inclined line-group keytone.

20 24. The printer engine as claimed in any of claims 19 to 23, wherein said table stores a threshold value matrix which is used to always simultaneously generate three or more dots per gradation level.

25 25. The printer engine as claimed in any of claims

19 to 24, wherein a threshold value immediately before

switching a dot size has a value identical to a first

threshold value for a dot size of a next stage, within the

threshold value matrix.

5

26.   The printer engine as claimed in any of claims

19 to 25, wherein said table stores the threshold value matrix

excluding a matrix which independently generates a dense dot

pattern for which a keytone is not visually recognizable by

10   human eye.

27.   The printer engine as claimed in any of claims

19 to 26, wherein said table stores the threshold value matrix

in which only odd numbered threshold values are used to form

15   an incomplete set of dots at a gradation level where a keytone

is easily lost due to increased dot density.

28.   The printer engine as claimed in any of claims

19 to 27, wherein one side of the threshold value matrix is

20   always a multiple of eight.

29.   An image forming apparatus which forms an

image on a recording medium from a plurality of dots,

comprising:

25   a processing section carrying out a plural-level process

with respect to a multi-level image data to output a plural-level image data which represents a dot pattern by a smaller number of gradation levels than the multi-level image data by use of a threshold value matrix;

5   a table storing said threshold value matrix which includes threshold values which are used for making a dot representation solely by a dot pattern while maintaining an identical keytone for all halftone levels; and

an imaging section forming the image on the recording

10   medium based on the plural-level image data.

30.   The image forming apparatus as claimed in claim 29, wherein said processing section uses the threshold value matrix by rotating the threshold value matrix based on

15   the multi-level image data or specified output setting information.

31.   The image forming apparatus as claimed in claim 30, wherein said processing section rotates the

20   threshold value matrix so that directions of keytones are identical between a portrait mode which uses the recording medium vertically so that a longer side of the recording medium is vertical and a landscape mode which uses the recording medium horizontally so that the longer side of the

25   recording medium is horizontal.

32. The image forming apparatus as claimed in any of claims 29 to 31, wherein said threshold value matrix comprises a plurality of sub matrixes, and a basic matrix for combining the sub matrixes, said sub matrixes and said basic matrix having similar line-group keytones.

33. The image forming apparatus as claimed in claim 32, wherein at least said sub matrixes have a size of 3 x 3 and an inclined line-group keytone.

34. The image forming apparatus as claimed in any of claims 29 to 33, wherein said table stores a threshold value matrix which is used to always simultaneously generate three or more dots per gradation level.

35. The image forming apparatus as claimed in any of claims 29 to 34, wherein a threshold value immediately before switching a dot size has a value identical to a first threshold value for a dot size of a next stage, within the threshold value matrix.

36. The image forming apparatus as claimed in any of claims 29 to 35, wherein said table stores the threshold value matrix excluding a matrix which independently generates a dense dot pattern for which a keytone is not visually

recognizable by human eye.

37. The image forming apparatus as claimed in any of claims 29 to 36, wherein said table stores the threshold value matrix in which only odd numbered threshold values are used to form an incomplete set of dots at a gradation level where a keytone is easily lost due to increased dot density.

38. The image forming apparatus as claimed in any of claims 29 to 37, wherein one side of the threshold value matrix is always a multiple of eight.